Cost Effective IoT- RFID Attendance Database Management System using ESP8266

Roshan P. Singh[1], Luqman Khan[2], Joyson J. Pereira[3], Aashray S. Singh[4], Saurabh Maurya[5]

[1,2,3,4,5]*PG -Master of Science Physics, KJ Somaiya College of Science and Commerce, University of Mumbai, Mumbai, Maharashtra, India.*

Emails: *roshan.ps@somaiya.edu[1], luqman.khan@somaiya.edu[2], joyson.p@somaiya.edu[3], aashray.s@somaiya.edu[4], saurabh.maurya@somaiya.edu[5]*

Abstract

Attendance tracking remains an essential yet often cumbersome task for educational institutions and organizations. Conventional methods consume substantial time and effort. In this paper, we endeavor these limitations with an innovative and cost-effective solution. An Internet of Things (IoT) based attendance management system that harnesses the power of Radio Frequency Identification (RFID) technology. At the core of this system lies the ESP8266, a widely available and inexpensive Wi-Fi-enabled microcontroller. By seamlessly integrating an RFID reader with the ESP8266 and a database, the system automates the attendance recording process. Students or employees need to only tap their RFID cards or tags, and their attendance data is instantly and accurately captured, eliminating the potential for manual errors. The solution's significance lies in its multifaceted advantages, including automated attendance tracking, real-time data accessibility, and cost-effectiveness facilitated by the use of affordable hardware components. Future research may explore additional features, scalability options, and integration with other IoT systems to augment its capabilities further, this innovative IoT-RFID attendance system represents a significant stride towards modernizing attendance management practices while delivering cost-effective and reliable solutions.

Keywords: *IoT, RFID, ESP8266, Attendance.*

1. Introduction

In today's fast-paced world, traditional methods of attendance tracking in various institutions have become time-consuming and inefficient. These methods lack real-time visibility, making it difficult to address issues like student absenteeism and proxy attendance. Manual attendance management has been a staple in the educational system, requiring significant administrative efforts, consuming valuable time, and prone to errors. To address these challenges, Radio Frequency Identification RFID technology has been introduced that offers a practical solution to streamline attendance tracking and managing processes. By using RFID-based Attendance systems, the accuracy and overall time-consuming issues in managing student attendance can be addressed. Integrating RFID with IoT principles allows for interconnected devices and real-time data communication. IoT facilitates seamless data exchange between RFID readers, and databases enabling remote monitoring and instant access to attendance information. This paper proposes an innovative and cost-effective attendance monitoring solution that combines RFID technology, IoT principles, and the low-cost, Wi-Fi-enabled ESP8266 microcontroller. The proposed system can seamlessly integrate RFID readers with a centralized attendance database, enabling real-time data synchronization and remote monitoring capabilities. The RFID reader captures attendance data and wirelessly transmits it to a central database using the ESP8266's Wi-Fi capabilities. This wireless approach eliminates the need for expensive wired systems, reducing maintenance costs and enhancing the overall system design. With the integration of RFID technology, educational institutions can revolutionize their attendance monitoring processes, paving the way for enhanced efficiency and accuracy. By automating attendance

tracking, institutions can reduce administrative burdens and time, minimize errors, and allocate resources more effectively. [1&2]

1.1 Literature Review

Ms.G.T. Bharathy, Ms.S. Bhavanisankari, T. Tamilselvi [2021]: The proposed system is an IoT-based smart attendance system using RFID. The existing manual attendance registration can be transformed into an efficient and error-free attendance management system. This system also consists of a GSM module system to send messages to parents or authorized persons and a GPS module system that gets the live location of students. The proposed system is easy to handle and very convenient for organizations. [3]

Hariom Krishna and Narayan Vyas [2022]: The proposed system focuses on better user interaction facilities for attendance monitoring and it is WI-FI enabled which makes it a portable device. Mobile applications are also developed that provide multiple device management facilities so that we can use multiple devices in a single user account. The application provides facilities to generate advanced sorting and filtering options. It also allows users to share reports directly from the application screen. For security purposes, google's Firebase management system is used for credential information and security of the user's data system.It can also provide a backup of the database which is provided as per the demand.[4]

Prine Ana, Ukoette Jeremiah Ekah, Emmanuel Oyojta. [2022]: The proposed system aims to provide a safe and secure environment on campus, a biometric security system is key. Biometric security systems are unique to each person, permanent, fast, accurate, not subjected to change, and impossible to forge. This system uses a fingerprint sensor with a microcontroller ESP32 and an OLED display for displaying the name and roll number of students. This system reduced the level of fraud and data manipulation in filling the attendance list during lectures and examinations. [5]

Deki Juniasyah, Novi Herawadi, Danang Ade Muktiawan [2023]: The proposed system aims to make it easier to manage attendance and calculate salaries, as well as ensure that people who must attend activities actually attended. Using RFID and ESP8266 microcontrollers, they developed an attendance system and successfully implemented it. The user's time stored in the database when making a presence corresponds to the real-time when making a presence. [6]

2. Proposed System

In this paper, a system has been proposed which replaces inefficient manual attendance with an automated system, reducing the time and effort required for attendance tracking. It utilizes RFID technology for secure and accurate identification of individuals, minimizing the possibility of errors in attendance records. It incorporates a user database with predefined card-UID (Unique ID) associations, allowing easy customization for different users. This system logs attendance data in real-time, enabling immediate monitoring and analysis of attendance patterns and minimizes the chances of proxy attendance, ensuring the reliability of attendance records. It also provides a centralized and easily accessible database of attendance records.
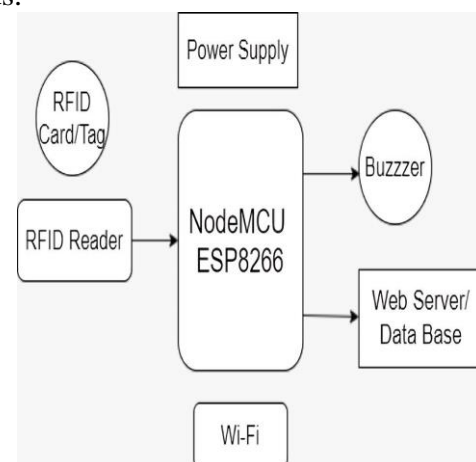

Figure 1 Block Diagram

3. System Components

The attendance management system has three main components: the RFID card, the RFID reader connected to the ESP8266 microcontroller and the web-based interface for monitoring and recording attendance information. Figure 1 & 2 shows the

block diagram of system components & flowchart of the proposed system.
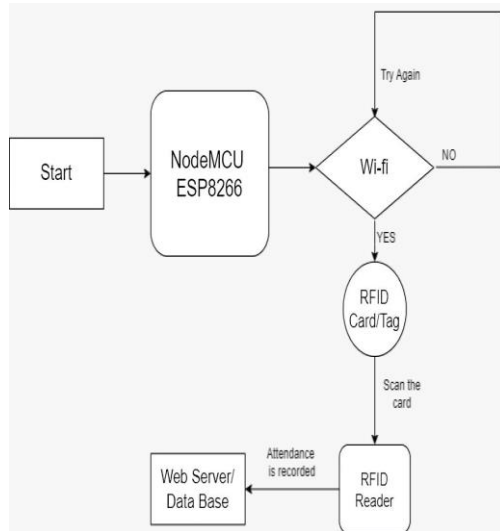

Figure 2 Flow Chart

3.1 Passive RFID Cards/Tags and RFID Reader

RFID cards (Figure 3) (eg. Student ID cards) are a type of RFID technology that does not have an internal power source such as a battery. Instead, these cards rely on the power provided by the RFID reader to communicate. Each tag has a unique identification number (UID) that an RFID reader can read. In the proposed system, when students scan their RFID card (in this case their ID card) through the system, their attendance will get recorded automatically. The RFID reader (Figure 4) is responsible for detecting the reading of the unique identification numbers from the RFID tags within its range. [7]

Figure 3 Rfid Tags

Figure 4 Rfid Reader

3.2 Esp8266 Nodemcu

The ESP8266 NODEMCU (FIGURE 5.) features a Tensilica L106 32-bit microcontroller unit (MCU) with integrated Wi-Fi connectivity, making it suitable for IoT applications. It is connected to the RFID reader and is the system's central processing unit. It collects the data from the RFID reader, processes it, and transmits the attendance information to a web-based server/website via Wi-Fi. RFID technology utilizes electromagnetic fields to identify and track tags attached to objects or individuals. The RFID module communicates with the host microcontroller via the SPI interface and provides functions for reading and writing RFID tags/cards. The MFRC522 RFID module is commonly employed for RFID applications due to its compatibility and reliability. The ESP8266's low cost and Wi-Fi capabilities make it an ideal choice for this application.
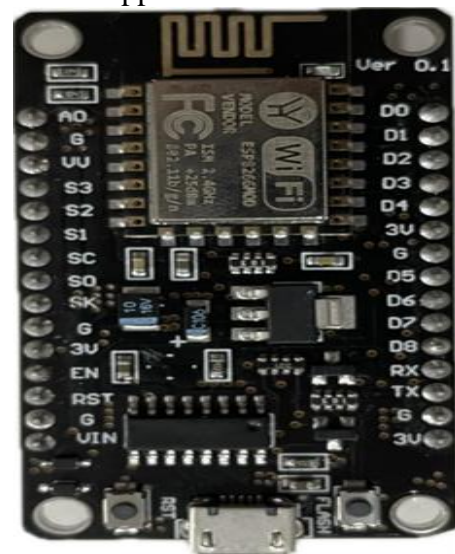

Figure 5 Node Mcu Esp8266

3.3 Web-based Interface

The web-based interface serves as the user interface for attendance monitoring and management. It receives the attendance data from the ESP8266 and displays it in a user-friendly format. Administrators can view real-time attendance records, generate reports, and manage user profiles through the web interface. The web interface also allows for the configuration of more than one device, with a unique device ID
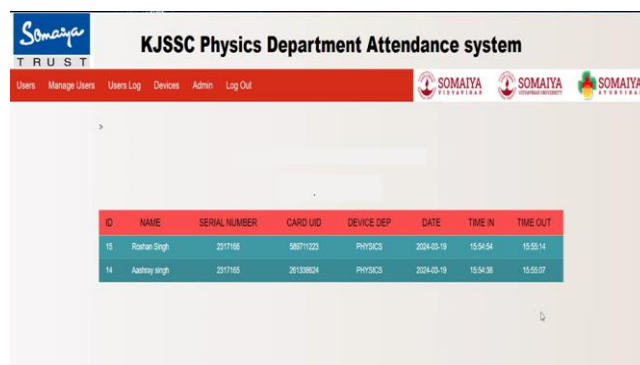
4. System Implementation

The implementation of the proposed system involves the following steps:

- Configuring the ESP8266 microcontroller and connecting it to the RFID reader.
- Programming the ESP8266 to read data from the RFID reader and transmit it to a web server using its Wi-Fi capabilities.
- Develop a web-based application to receive and process the attendance data from the ESP8266.
- Designing and implementing a user-friendly interface for attendance monitoring and reporting, including real-time attendance tracking, report generation, and user management featuring and evaluating the system's accuracy, efficiency, and user experience in various scenarios and environments.

5. Results and Discussion

Our proposed IoT-RFID Attendance data management System using the ESP8266 yielded promising results, demonstrating its effectiveness in making attendance tracking processes streamlined in educational and various other institutions. In our experimental setup, we simulated a typical educational environment, deploying RFID reader modules at entry points and configuring ESP8266 microcontrollers to communicate with the centralized database server via Wi-Fi connectivity. The response times for data transmission between the ESP8266 microcontrollers and the centralized database server were consistently rapid. Admin can view the Attendance record as shown in Figure 6. Potential challenges and limitations of the system may include issues related to RFID tag interference,

range limitations of the RFID reader, and network connectivity for transmitting attendance data to the web server.

Figure 6 Attendance Record

Conclusion

The proposed system demonstrates the feasibility and efficacy of the Attendance management system utilizing the ESP8266 microcontroller. By implementing this solution institution can modernize their attendance management process while minimizing costs and administrative overhead. Our study represents a step forward in the advancement of attendance systems but it is also important to acknowledge certain limitations which may further endeavor to enhance the utility and value of the system. Through continued innovation and refinement, we envision a future where attendance management becomes seamlessly integrated with various institutions.

Acknowledgements

References

[1]. Joseph D. I., Emmalia A., and Akh F. (2018). RFID and IoT for Attendance Monitoring System. Materials Science, Engineering and Chemistry(MATEC) Web of Conferences, Vol 164, Published 23, April 2018.doi: 10.1051/matecconf/201816401020.

[2]. Ajay J., Aman A., Arpit S. and Poonam J. (2021). RFID-Based Attendance System. International Journal for Modern Trends in Science and Technology, Vol. 07, Issue 01, January 2021, pp.-40-43. doi: 10.46501/IJMTST0701009.

[3]. Ms.G.T. Bharathy, Ms.S. Bhavanisankari, T. Tamilselvi (2021). Smart Attendance Monitoring System Using IoT and RFID. International Journal of Advances in Engineering and Management(IJAEM). Vol. 03, Issue 06, June 2021, pp: 1307-1313. doi: 10.35629/5252-030613071313.

[4]. Hariom K. and Narayan V. (2022). RFID-Based Attendance Monitoring System Using ESP8266 Wi-Fi Module and IoT Enabled Mobile Application. NeuroQuantology, Vol. 20, Issue 09, September 2022.doi: 10.14704/nq.2022.20.9.NQ44681.

[5]. Prine Ana, Ukoette Jeremiah Ekah, Emmanuel Oyojta. (2022). IOT-based biometric attendance system for CRUTECH. International Journal of Science and Research Archive (IJSRA), Issue 29, January 2022.doi: 10.30574/ijsra.2022.5.1.0035.

[6]. Deki Juniasyah, Novi Herawadi, Danang Ade Muktiawan (2023). Design of A Laboratory Assistant Presence System Using Rfid Sensor and Web-Based Esp8266 Microcontroller. 9th Proceeding International Conference on Information Technology and Business (P-ICITB) Issue 2023, in Press.

[7]. Anurag Shrivastava, S. J. Suji Prasad, Ajay Reddy Yeruva, P. Mani, Pooja Nagpal & Abhay Chaturvedi (2023). IoT-Based RFID Attendance Monitoring System of Students using Arduino ESP8266 & Adafruit.io on Defined Area. Cybernetics and Systems: An International Journal, Vol. 03, Issue 10, October 2020.doi: 10.1080/01969722.2023.2166243